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## RESEARCH IN MARKETING

The potato grower is beset with difficulties from the day he begins to cut his seed potatoes until the crop reaches the market. He may purchase certified seed but, failing to practice seed disinfection, he may experience serious losses from diseases. Again, serious seed piece decay may follow from improper care of the cut seed pieces. He must also adjust the reaction of his soil properly to prevent losses from scab, but, on the other hand, if he is not careful, he may create such an acid condition that the yield will be very much reduced.

When he is ready to plant, his troubles are only begun. From the improper application of fertilizer, poor stands and subsequent low yields may result. Even though he avoids all these difficulties, he will still face many hurdles before he can consider the race won. He must contend with various insect and disease pests which attack the plant both above and below ground. It may be too wet and again, most serious of all—it may be so dry that only a small crop results. During the harvesting operation he may lose a considerable portion from bruises, sunscald and other difficulties. Even when the crop is safely in storage, the grower's troubles have by no means terminated, since losses from rots and other troubles may follow from improper storage. The wide-awake grower is usually able to overcome the many difficulties which confront him, but there is little that he can do about the selling price. In most cases, he must accept what the market offers. Some progress has been made in improving the situation through cooperative effort but the present methods of selling the crop are still far from satisfactory. Research has developed methods whereby many of the risks in potato growing have been eliminated. There is real need, however, for a better system of merchandising in most areas and more thought must be given to this if the grower is to realize maximum returns on his crops.

## THE BIOLOGICAL BASIS FOR CERTIFICATION OF SEED POTATOES<sup>1, 2</sup>

J. G. LEACH

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Plant disease control was at one time the responsibility of the individual. The individual farmer was completely dependent upon his own resources for the protection of his crops against loss from diseases and insect pests. In relatively recent times the state has assumed some of this responsibility. First, the problem of research into the nature, cause, and methods of control was recognized as a function of the government, and research in plant pathology became a part of experiment station work. The educational responsibilities were soon taken over by the agricultural colleges and extension service.

With the steadily increasing knowledge of plant diseases and the methods by which they are spread it has been realized that effective control of certain diseases can be accomplished only through regulatory measures enforced by government action. Plant disease quarantines and eradication programs were among the first organized attempts at direct plant disease control through government agencies. Seed potato certification is one of the more recent efforts of the state to aid the farmer in the control of the diseases that threaten his crops.

Seed potato certification in this country is a little more than 20 years old the first fields having been certified in Wisconsin in 1914. The development of the industry has been relatively rapid. At the present time about ten to fifteen million bushels of seed potatoes are certified annually in twenty-four states. This constitutes from one-fourth to one-third of the total seed potatoes used annually. The strong demand for certified seed is evidence of the degree to which certification has been successful. However the increased yields of high quality potatoes usually obtained from certified stock as compared with ordinary stock would apparently justify a much more extensive use of certified seed. Insufficient education of the public regarding the value of certified seed may explain why more certified seed is not used but it is also probable that a lack of uniformity in the quality of certified seed may also be a factor. Despite the success

1. Address delivered at the conference on phytopathological problems at the Louisiana State University, Baton Rouge, La., Apr. 6, 1938.

2. Presented as Paper No. 374 of the Miscellaneous Journal Series, at the Minnesota Agricultural Experiment Station.

of the certification movement no one would claim that our methods and procedures are perfect. Every one knows that there has been some dissatisfaction on the part of both consumer and producer. There is much room for improvement. This conference is a result of the recognition of this fact. It will be a disappointment to all of us if the conference does not result in action that will improve the efficiency and uniformity of certification and facilitate the control of potato diseases through more general use of good seed stock.

The aim of seed potato certification is to produce and make available supplies of seed tubers that are (1) true to variety and type, and (2) free from disease (using disease in the broad sense to include any condition that tends to reduce yield or quality of the resulting crop). The first of these two aims has been realized to the relative satisfaction of all concerned. Before certification was started the same variety was often sold under many different names, and varietal mixtures were the rule rather than the exception. The purchase of seed potatoes in the past was much in the nature of a lottery, and the cards were usually stacked against the purchaser. However, this difficulty has been largely overcome with the aid of the excellent work of Stuart on the classification of potato varieties and the cooperative approval of standard varieties and variety names by the various certifying agencies. Varietal purity is no longer a major problem in the seed potato trade.

The second objective has not been reached so easily. It is true that much has been accomplished in the production of healthy seed stocks, but the lack of uniformity of certified seed in respect to freedom from disease is a condition that leaves much to be desired. Some of this variation may be explained by the lack of uniformity in certification tolerances of disease by different certifying agencies, but much will have to be attributed to more fundamental biological causes. Potato diseases are complicated biological processes, and they are greatly modified by environmental factors. They do not always act according to our expectations. An accurate quantitative measurement of disease infection is often very difficult. Inability to detect the presence of a disease or to measure it accurately, on the one hand, and rejection of seed lots based on inaccurate diagnosis, on the other hand, has been responsible for much of the dissatisfaction and many of the misunderstandings concerning certified seed. Certification, to be effective and efficient, must operate under rules and regulations that have a sound biological basis. This means that the rules must take into consideration all available knowledge of the diseases con-

cerned. Of the things that should be known as a basis for sound regulations, these may be mentioned as being of prime importance: (1) An accurate knowledge of the extent to which a disease is transmitted in or on the seed tubers; (2) the recognition of all other sources of infection, and (3) an accurate evaluation of the different sources of infection under various circumstances.

These things are not definitely known for some of the potato diseases and when known are not thoroughly appreciated by many who are concerned in some way with certified seed. It is important that those who have the responsibility of administering any phase of certification know and understand these three factors concerning potato diseases covered by certification regulations. Rules and regulations formulated or administered on any other basis are sure to be unsatisfactory. Every unsatisfactory regulation makes certification more difficult and adds to the cost of certified seed. With these facts in mind let us review some of the diseases dealt with in certification work.

*The Virus Diseases.* Potato seed certification originated through our efforts to control the virus diseases of potatoes. When it was learned that the long recognized degeneration of potato seed stocks was caused by virus diseases that were infectious, and were perpetuated through the tubers produced on infected plants, it became evident that they could be controlled only by selecting and maintaining disease-free stock. Therefore, a system of inspection and certification of the disease-free stock was the natural result. When the system was inaugurated, naturally attempts were made to use the same machinery to control other diseases either known or thought to be tuber-transmitted. The control of the latter group of diseases has not been so successful as that of the virus diseases. The control of virus diseases was originally, and still is, the most important and effective function of seed potato certification.

Certification has been relatively successful regarding the control of virus diseases, but it is far from perfect. One of the greatest difficulties lies in the human errors made in inspection. There are all gradations in the severity of symptoms of virus diseases, and the infected plants are often difficult to locate with accuracy. This is especially true in hot dry weather that often prevails when inspections must be made.

Current season infection that produces no symptoms until the succeeding generation is also the cause of much difficulty. When the accuracy of field inspections is in doubt a greenhouse test is desirable

but is often not possible. Increased facilities for greenhouse tests would add to the efficiency of virus disease control. It would probably also add to the cost of certified seed. Whenever the performance of certified seed is compared with certification records, due allowance must be made for the increment that can be attributed to current season infection. By the same token, current season infection should never be used as an alibi for poor seed. The human element looms large in certification. One can not depend too much on mathematical precision in measuring biological processes. A mutual desire for fair play is indispensable.

Virus diseases are cumulative, not only in potatoes but in weeds and in insects. When potatoes are grown intensively in a local region it often becomes difficult to maintain virus-free stock. The rigid use of the isolated hill-unit and tuber-unit seed plot is helping to meet the situation, but in regions of intensive potato culture it is necessary for the grower to replace his stock at frequent intervals with registered foundation stock grown on the smaller farms in the more isolated regions. The increased use of foundation stock by certified seed growers is doing much to maintain the efficiency of virus disease control. It is really a practice that should be encouraged.

The potato-virus-disease complex involves many different viruses. Some of the viruses and virus complexes are prevalent in certain seed-producing regions and rare in others. In a like manner some of the viruses are more destructive in some southern regions than in others. For this reason it is obviously impossible to have uniform tolerances for specific virus diseases in all seed-producing areas. It is the opinion of the writer that we should strive for uniform tolerances for all viruses combined, but the tolerances for the specific viruses should be left to the different states certifying the seed.

*Scab.* Scab, the most universal of all potato diseases, is seed transmitted to a limited extent only. The pathogene is a constant inhabitant of many soils. Severe infection can rarely be attributed solely to seed infection but is nearly always caused by infested soil. Nevertheless, the amount and severity may be influenced by infected seed, and no one wishes to plant very scabby seed. Because seed-borne scab infection may be eliminated by seed treatment it is not so serious a matter as virus infection. Seed stock that is satisfactory in other respects should not be rejected because of relatively small amounts of scab infection. There has been much confusion and lack of uniformity in scab tolerances and in the methods of measuring



scab infection. Damage by scab should be defined and the tolerances given in terms of percentage of tubers allowed with scab damage as defined. The definition of damage by scab recommended in the last report of the committee on certification of the Potato Association appears to be reasonable. This states that a tuber having more than 3 per cent of its surface covered with scab is damaged for seed purposes. Tolerances should be stated as a definite percentage by weight of tubers damaged by scab as defined. A uniform tolerance should be adopted by all certifying agencies. If the 3 per cent standard for scab damage is used I believe that the tolerances should be reasonably liberal, not less than 10 per cent.

*Rhizoctonia*. What has been said about scab is largely true for *Rhizoctonia*. In view of the efficiency of tuber disinfection, the tolerance of *Rhizoctonia* should be liberal. The committee on certification has recommended that a tuber with more than 5 per cent of its surface covered with sclerotia be considered as damaged for seed purposes. The tolerance should be stated in terms of the percentage by weight of tubers allowed with more than 5 per cent of its surface covered with sclerotia. A 10 per cent tolerance would seem to be satisfactory.

*Fusarium wilt*. The *Fusarium* wilts are diseases concerning which there have been many erroneous conceptions. The early work of Smith and Swingle led us to believe that the disease was transmitted chiefly through infected seed tubers and could be controlled largely by planting healthy tubers. It was assumed by many workers and teachers that stem-end discoloration was an infallible symptom of *Fusarium* wilt and that tubers with stem-end discoloration would universally produce wilted plants. In spite of the fact that later work has shown that these assumptions are not justified they have persisted with surprising tenacity.

As early as 1920 Edson reported extensive experiments with tubers showing stem-end discoloration and concluded that "neither vascular discoloration nor fungous invasion of the tissues of the mother tuber is a guarantee of disease in the resulting plants, nor is their absence a guarantee of health. The soil and not the tuber appeared to have been the more potent source of disease." Goss has shown that the *Fusarium* wilts occur in virgin soil, and he also concludes that, "Over a period of years our experience has been that soil known to be heavily infested is more dangerous to use than infected seed." Although Goss presented data showing that wilt could be transmitted through infected tubers he added, "Of course it must be



remembered that in these tests all the seed pieces were infected. In commercial seed stocks with a small percentage of slightly infected tubers, the resulting disease would hardly be detectable."

It is also well established that stem-end discoloration may be caused by many environmental factors and that it is practically impossible to distinguish other types of discoloration from those caused by wilt. McKay in his extensive studies of wilt in Oregon stated that, "The presence of discoloration in the stem-end vascular region of potato tubers is not a trustworthy index of the presence of disease-producing organisms therein. . . ."

It would seem therefore that the practice of allowing tolerances for *Fusarium* wilt based on bin inspection is not predicated on sound biological principles. The practice is based on the erroneous assumption that vascular discoloration is a reliable symptom of wilt infection and by implication puts an unjustified emphasis on seed infection as a source of wilt. The difficulty lies not alone in the rules themselves but also in the dissatisfaction of the grower who is led to believe that the planting of certified seed will insure him against wilt and that of the producer who may have his seed rejected on the basis of supposed *Fusarium* wilt when he knows that he had no wilt in his field.

It would seem more logical and more satisfactory not to have a tolerance of *Fusarium* wilt based on bin inspection but to have a tolerance for stem-end or vascular discoloration of sufficient severity that the vigor of the seed is obviously injured. Stem-end discoloration should be considered as a grade defect and not as a specific disease.

*Verticillium Wilt.* I have had no first-hand experience with *Verticillium Wilt* but according to McKay, who has studied the disease more extensively than any one else, it is transmitted through infected tubers to a greater extent than the *Fusarium* wilts. However, since the same difficulty in diagnosing infected tubers is recognized, bin inspection would probably be no more effective for this disease than for *Fusarium* wilt. The low tolerance of field infection would appear to be justified.

*The "Z" disease.* A wilt disease of some importance has been reported from New York State under the name of "Z" disease. The cause of the "Z" disease has not been reported and nothing has been published concerning its method of spread. It is hoped that some definite information upon which to base certification procedure will be available soon.

*Black leg.* Black leg in all probability has been the cause of more trouble and dissatisfaction in certification than any other disease. When certification was first established it was the prevailing belief that black leg was transmitted entirely through infected seed stock and that the pathogene could not survive in the soil. The first certification regulations were based on these assumptions. Although it has been demonstrated that these beliefs were contrary to fact no appreciable changes have been made in the regulations, and many of the purchasers of certified seed buy their seed with the belief that any black leg that may appear in their fields may be attributed to infected seed stock. The extremely low tolerance of black leg infection lends encouragement to this belief and constitutes a good example of regulations based on unsound biological principles.

Nearly ten years ago I demonstrated that seed transmission of black leg is relatively rare and that heavy outbreaks may occur in fields planted from seed grown in fields free from black leg. It was shown that the black leg pathogene was the same organism that caused soft rot of many vegetable plants; that it occurred in most agricultural soils; that infections could arise directly from the soil under favorable conditions or could develop when the seed pieces were attacked by the seed-corn maggot. It was shown that when tubers from plants that were killed by black leg were planted, an average of not more than eleven per cent of the resulting plants were affected with black leg, and all of this may not have been tuber-transmitted. At this rate field-run seed from a field with black leg exceeding many times the tolerance would yield only a trace of black leg.

The failure to recognize the fact that black leg can not be controlled by certification is unfortunate, not only because of the wasted effort and expense spent in roughing fields, but because of the dissatisfaction on the part of both the producer and the customer. The grower who suffers loss from black leg after planting certified seed blames the producer. If the producer is penalized when he knows that his fields were free from black leg he is disgruntled and is less likely to "play the game fairly." If we can not control black leg through certification, and I am convinced that we can not, the sooner we admit it and recognize the facts in our regulations, the sooner will we remove one of the most disturbing factors in potato certification.

Dr. Bonde, who has investigated potato black leg and seed-piece decay in Maine and in South Carolina over a period of more than ten years has confirmed the above-mentioned results, and I have his per-

mission to quote his conclusions from a manuscript that is now in press.

Dr. Bonde states:

"The writer, when he began these studies, assumed that black leg plants would result when tubers from diseased plants were planted. However, he found in 1926 that only one per cent of black leg resulted from tubers selected from diseased hills the previous year.

"These results stimulated a further test of the amount of black leg that would result from planting diseased tubers. During the ten-year period from 1926 to 1935 inclusive, the writer selected tubers from hills that showed the symptoms of black leg in the field. These tubers from diseased hills were stored in a basement and were planted the following year under field conditions.

"It should be noted that the diseased stock for some years was planted not only in Maine, but in Florida, New York, and South Carolina. In some cases the tubers were separated according to the amount of vascular discoloration and other supposed signs of black leg infection, and the different lots selected on these bases were planted and recorded separately. The lots of seed were in most cases relatively large and the data secured from the test should be fairly reliable.

"The amount of black leg resulting from planting tubers from diseased hills only, varied from none to ten per cent. In many cases the amount of black leg that resulted was quite negligible and in no case was the percentage of the disease that resulted very high. The amount of disease from this source would have been negligible in fields planted from "field-run" tubers. Recently, other workers have reported similar results from planting progeny of diseased plants. Clayton, from experiments at Long Island, N. Y., drew the following conclusion, "Black leg is considered to be a seed-borne disease, but in experiments 3, 6, and 9, conducted during three successive years, the planting of seed from black leg-infected fields failed to produce the disease on Long Island." Gratz, from experiments in the Hastings, Florida potato-growing section, secured very similar results. In 1927 and 1928 he planted seed pieces taken from diseased tubers and secured only a small number of hills showing black leg.

"In contrast with these experiments it is a common experience to obtain much greater losses from black leg when planting disease-free stock. For the past ten seasons the writer and his associates have conducted an experimental seed plot on Aroostook Farm lo-

cated at Presque Isle, Maine. During this entire period until 1927 no black leg was encountered in these seed plots. However, in 1927 and also in 1928 disease-free tubers taken directly from the seed plot produced as high as twenty-one per cent black leg when planted in commercial fields. Furthermore, some new potato seedling varieties, grown disease-free in experimental seed plots, have had a considerable amount of black leg when grown the following year by farmers. It is of special interest that, in most cases where large black leg losses have been observed by the writer, the seed stock had been relatively free from this disease during the preceding year."

<sup>1</sup>Quoted from pages 19-20 from a manuscript by Reiner Bonde "A study of black leg and seed-piece decay in the Irish Potato").

"The different states have rigid rules regarding the amount of black leg permitted in potatoes certified for the seed trade. The tolerance in most cases is rather small and many fields are rejected each year because of the black leg disease being present in amounts in excess of that permitted by the rules. Other growers expend large sums of money in eliminating this disease from their fields by roguing. The writer feels that the certification requirements regarding black leg were formulated on incomplete information and that too much emphasis has been placed on the presence of relatively small amounts of this disease in the field. His studies indicate that the epidemics of this disease that often occur cannot be attributed to the presence of a small number of infected plants being present in the field from which the seed stock originated. Other factors seem to be more important in bringing about poor stands and epidemics of black leg. The seed may become contaminated with pathogenic organisms from the soil or by bacteria associated with various kinds of fungous lesions. Contaminated seed that has been injured by excessive drying of the freshly-cut surfaces, or by being stored under unfavorable conditions for healing and suberization, may give rise to large amounts of the disease. The presence of certain insects in poorly healed seed stock may also be an important factor in the production of epidemics of black leg. It is believed that the different seed-potato certification agencies should reconsider the rules in regard to black leg tolerance and formulate new ones based on the more recently available evidence."

<sup>1</sup>Quoted from pages 136-137 from a manuscript by Reiner Bonde "A study of black leg and seed-piece decay in the Irish Potato").

At this point I would like to emphasize that although certification attempts to avoid losses from potato diseases it can not always

succeed. When losses do occur it should be the aim of the inspectors and certification officials to place the responsibility where it belongs. If the purchaser of certified seed feels that he has been forced to bear a loss unjustly he is less likely to deal fairly in future contracts. In the same manner if a grower of certified seed takes a loss from a disease for which he is convinced he is not to blame it is only human nature that he will try to get it back next time. Successful certification is dependent to a large extent upon the honesty and spirit of fair play of both producer and consumer. At best, the certification official at either end of the line needs the wisdom of a Moses to keep peace in his family of producers and consumers. It is next to impossible unless the rules and regulations are based on sound biology.

*Late Blight.* I can not speak with any degree of authority concerning late blight; I have never had the opportunity of working with it. The disease can be controlled reasonably well by spraying. Although the degree to which epidemics can be traced to infected seed is debatable, insofar as I know the certification tolerances allowed and the results obtained have been fairly satisfactory.

*Bacterial Wilt (Phytophthora solanacearum).* This disease appears to be confined largely to the southern part of the country and is not a factor in certification in the northern states. The disease has never been observed in Minnesota. The extent to which this disease is transmitted through the tubers is not definitely known. The available evidence indicates that the soil is the most important source of infection.

*Bacterial Wilt (ring disease).* The bacterial disease recently reported in Maine by Bonde, and in Quebec by Racicot and Savile appears to be similar to, or the same as, the Ringfäule first described by Spiekermann. This disease has been known in Germany for many years. According to the report of Racicot and Savile, as well as European workers, it is readily transmitted through infected tubers. On account of the destructive nature of the disease and the high degree of seed transmission, one would conclude that none of this disease should be allowed in certified fields pending a more thorough study of the disease.

*Psyllid Yellows.* The evidence indicates that psyllid yellows is not a virus disease, is not infectious, and is not perpetuated through the tubers. It apparently is caused by a toxicogenic insect, the tomato psyllid. Although it is not transmitted through the tubers Metzger has shown that, where the disease is present in relatively large amounts, there is a significant influence on the vigor of the plants



when the tubers are used as seed. The liberal tolerance of fifteen per cent recommended by Metzger would appear to be justified for this noninfectious disease.

*Purple Top Wilt.* A previously unrecognized disease of potatoes made its appearance in certain sections of the country in 1935. In Minnesota it was originally diagnosed as a *Fusarium* wilt with atypical symptoms but was later shown not to be caused by fungi. The same or a similar disease was reported from Wisconsin and attributed to *Fusarium avenaceum*. The "blue stem" disease reported from West Virginia appears to be the same, or a similar trouble. Blue stem is not caused by fungi, but the true cause has not been discovered.

It is evident that until more is known about the nature and cause of this disease certification regulations will have to be tentative only.

Investigations on this disease conducted in Minnesota have established the following significant facts: (1) Affected plants show no symptoms until tuberization is under way but continue from that time and are prominent until frost; (2) the translocation of elaborated materials is inhibited, resulting in excessive production of red pigments in the apical leaves, and excessive development of axillary shoots in which carbohydrates are stored and often result in aerial tubers. An upward rolling of the leaves occurs, and about ten days later the plant wilts; (3) necrosis of the base of the stem and a browning of the vascular bundles of the lower half of the stem are characteristic; (4) the necrotic areas and the browned vascular bundles are usually invaded by saprophytic *Fusaria* and other non-pathogenic fungi; (5) the disease is not transmitted as such through the tubers; (6) it is not controlled through careful roguing and selection of healthy plants; (7) it occurs in the usual amounts when healthy tubers are planted on virgin soil; (8) in hill-unit and tuber-unit plots the disease is not in any way correlated with the hill or tuber units; (9) early varieties planted early and harvested early tend to escape. The later, long-season varieties appear to be more resistant than midseason varieties; (10) fertilizers influence the disease only to the extent that the higher percentages were found on the plots supporting the more vigorous growth; (11) the reduction in yield is in proportion to the earliness of the appearance of the symptoms; and (12) tubers from plants affected early often give weak plants but the plants do not wilt.

The behavior of the disease indicates that it may be similar to

psyllid yellows and be caused by a toxicogenic insect. Psyllids, however, are not present. The tarnished plant bug is suspected, but its relationship to the disease has not been proved. Therefore, until more is known about the disease and its cause, all regulations should be tentative.

*Hair Sprout.* This is not a new disease. It has been recognized for at least twenty-three years but has never occurred in destructive amounts until recently. In certain regions of the country the tubers grown in 1937, especially those of the Triumph and White Rose varieties, in many cases produced high percentages of spindling sprout. Affected tubers often but not always sprout prematurely; the sprouts are extremely small, and apical dominance is lost. Such tubers are worthless for seed. The cause of spindling sprout has never been definitely determined. Stewart who first recognized the condition in this country attributed it to the effect of heat and drought during the growing season. Since then it has been attributed to leafroll, *Fusarium* wilt, and numerous other factors. It is possible that the condition may be caused by either of several different factors. Whatever the cause may be, it is still not definitely known. The unusually large amount of spindling sprout that was found in some lots of Triumph potatoes in Minnesota this year could not have been caused by leaf roll which was not observed in appreciable amounts last summer.

On account of the prevalence of "purple top wilt" in 1937 a relationship with that disease has been suggested, but there is much conflicting evidence. If the relationship exists it does not hold for the Chippewa and Warba varieties. These varieties are very susceptible to the "purple top wilt," but from 125 selected hills, all affected with wilt, not a single case of spindling sprout resulted. Unfortunately, I have not worked extensively with the Triumph variety. However, one tuber-unit seed plot of Triumph grown in Minnesota, in which no wilt plants were saved in 1936, produced 56 per cent hair sprout in 1937. I am inclined to believe that the two conditions are not related although I would prefer to withhold final judgment until more experimental data are available.

A small amount of spindling sprout was observed in a few seed lots of the Chippewa variety in Minnesota in 1935. When a number that tended to recover as the season advanced. Tubers produced on of spindling sprout tubers were planted they produced weak plants



these plants when planted the following year gave normal vigorous plants. These data, although not conclusive, indicate that the condition is not perpetuated through the tubers. It does not appear to be a virus disease. Regardless of the nature and cause of the disease it is obvious that affected tubers are not suitable for seed and should not be sold as such.

There appears to be no reliable way of predicting the occurrence of spindling sprout from field inspection. It can be detected only by means of a sprout test. When the tubers affected with spindling sprout are removed, the value of the remaining tubers appears to be unimpaired. Unless evidence to the contrary is obtained it would seem that we would be justified, for the time being, in considering spindling sprout as a grade defect subject to removal by sorting.

It is evident that at present we do not know enough about the disease to formulate rules and regulations of a final nature. We must build a temporary bridge to enable us to do business until a more permanent structure, based on more complete information, can be erected. I would suggest a procedure somewhat as follows: A tolerance of 5 per cent spindling sprout be allowed. If the count at destination reveals spindling sprout exceeding 5 per cent, the excess should be subject to removal under the supervision of a state official at the expense of the shipper and the adjustments should be made in proportion to the amount of spindling sprout tubers removed (in excess of 3 per cent). If this temporary procedure is put into effect it would be necessary to waive temporarily the restrictions on partly sprouted tubers.

In the meantime, investigations into the nature and cause of spindling sprout and purple top wilt should be prosecuted as rapidly as possible in order that more stable regulations formulated on a sound basis may be established. The same may be said for the the "Z" disease, and the recently reported bacterial disease.

In conclusion I would like to repeat that certification has proven its value as a method of potato disease control. Its success would seem to justify its expansion. This can be brought about partly by better education of the public regarding the value of certified seed potatoes, but much can be done by increasing the uniformity and reliability of certified seed. One way of doing this is to stimulate and maintain a high standard of ethics in all dealings between producer and consumer. One aid in maintaining this standard is to be sure that the rules and regulations are based on sound biological principles. Regulations that give false hope that a disease may be completely con-

trolled through certification can only result in injustice and dissatisfaction. For this reason I would suggest a reconsideration and liberalization of the black leg tolerances and a modification of the bin inspection for *Fusarium* wilt wherever it is now required. Uniform tolerances for the total of all virus diseases should be adopted, but uniformity of tolerance for individual virus diseases would not be practical or desirable.

Rules and regulations should be constantly scrutinized in the light of new information. The industry is faced with three or four new diseases of major importance to the seed industry. Final regulations to govern these diseases must await further investigation. The known facts should be carefully weighed in working out temporary regulations that will serve until more data are available.

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## REPORT OF SEED CERTIFICATION CONFERENCE

C. W. EDGERTON

*Louisiana State University, Baton Rouge, La.*

A conference to discuss problems connected with the certification of seed potatoes and to approve rules and regulations that might be adopted by regulatory departments of the various states was held at Baton Rouge, La. from the 5th to the 8th of April, 1938.

The conference was in charge of Dr. C. W. Edgerton, head of the Department of Botany, Louisiana State University, who was assisted by W. E. Anderson, entomologist in charge of regulatory work, Louisiana State Department of Agriculture, Dr. J. C. Miller, Horticulturist, Louisiana Agricultural Experiment Station, and G. L. Tiebout, Extension Horticulturist, Louisiana State University. Representatives from nineteen states and from the United States Department of Agriculture also attended the conference.

The first session was called on the 6th of April by C. W. Edgerton, Louisiana State University, who discussed briefly the objectives of the conference. Considerable certified seed which was unsatisfactory for seed purposes arrived in the southern states during the spring of 1938. High percentages of hair sprout, bacterial wilt, and mosaic were observed. Many of the purchasers of this seed were dissatisfied and the producers of the seed did not, in many cases, feel that they were entirely to blame.

It was also pointed out that the high percentages of hair sprout in seed potatoes forced certain of the plant boards in the South in charge of regulatory work to modify certain of their regulations temporarily regarding the entrance of certified seed into their states. As a result of this some of the plant board members thought it would be to their advantage if all of the states would work under the same regulations. In order to make this possible a committee from the various boards was appointed to draft a set of rules and regulations which could be adopted and used by all.

As the stage was set for a discussion of certification and regulatory problems, the conference at Baton Rouge was called and to it were invited all men who were interested in seed certification, including producers and consumers, and those in charge of the certification and the regulatory work. It seemed desirable to discuss the more recent problems of certification and to obtain the approval of both producers and consumers to a set of regulations which would be workable and would insure satisfactory seed to the purchaser. It was also stated that the Southern Plant Boards had no desire to set up impossible standards for certified seed or ask states which are furnishing satisfactory seed to change their methods of certification. Certain producing states have higher standards at the present time than will be required in the regulations which were submitted at the conference, and it is to be hoped that these states will continue to use such standards.

Dr. Edgerton stated that K. H. Fernow of Cornell University had been asked to preside at the conference and J. G. Leach of the University of Minnesota had been chosen for discussion leader.

Dr. Fernow took the chair and discussed briefly the problems to be considered by the conference. He stated that seed certification work began twenty-one years ago and consequently this conference may be considered a sort of birthday party for certified seed with friends and relatives gathered together to decide on its future.

Dr. Fernow discussed the rules and regulations governing certification and stated that "the main purpose of this conference is to try to bring about greater uniformity in certification requirements. A committee of the southern plant board members has been working for some time attempting to draw up a set of rules which they could apply to the seed from the North so that all southern states would have the same requirements; that seed unsatisfactory in one state could not be diverted into another state; and that northern shippers would not have to study and meet different requirements in the various states. Such regulations also may help to

make certification regulations in the North more uniform". He also stated that the conference could make headway by selecting committees to bring in reports on various subjects of interest. These reports could be used by the conference and also by the "Regulations" Committee.

The reports of the various committees follow:

H. O. Werner presented the following report of the Variety and Nomenclature Committee:

WHEREAS this committee considers certification to be a commercial service conducted for the purpose of certifying stocks of seed potatoes for trade purposes the committee on varieties and nomenclature recommend that the following practices be observed in connection with the certifying of seed potatoes:—

1. Tolerance for variety mixtures be placed at  $\frac{1}{4}$  of 1 per cent of plants for the second field inspection and by weight for the bin inspection and that these mixtures be sorted out as far as possible before final grade or shipping inspection.
2. A new variety be recognized for certification only after it has been named, described, and introduced by the breeder.
3. Strains, that, after adequate testing are found to be morphologically or genetically distinctive, be recognized for certification but the original variety name be retained with some descriptive number or adjective.
4. The United States Department of Agriculture be requested to take active steps to secure a comprehensive and uniform system for testing and describing new strains and varieties.

E. L. Newdick presented the following report of the committee on virus diseases:

After careful deliberation this committee recommends that the following tolerances for virus diseases be accepted by this conference.

	Per Cent
Rugose mosaic .....	2.0
Spindle Tuber .....	2.0
Leaf-roll .....	2.0
Total of above virus diseases not to exceed.	3.0
Mild mosaic .....	5.0

Other diseases known or suspected to be of virus origin, such as yellow dwarf, witches' broom, hay wire, giant hill rosette, spinach leaf, and curly dwarf... 2.0

R. J. Haskell presented the following report of the committee on bacterial wilt and late blight.

By bacterial wilt and soft rot is meant bacterial wilt of the vine and rot of the tubers as described by Bonde of Maine and Racicot and Saville of Canada. It occurs in Canada and Maine and in fields from Maine and Canadian seed in Florida, Pennsylvania, and possibly other states. A very similar, if not the same disease, has been reported from Colorado.

In Maine 5-10 per cent infected plants occurred in the fields in certain areas. As high as 35 per cent diseased plants have been observed. In Florida, in 1937, the loss from this disease was estimated by Edlins at \$100,000. This year, owing to precautionary measures, the loss is much less.

All the commonly grown (Spaulding, Rose, Katahdin, Triumph, Green Mountain) varieties have been found affected.

In the field, a wilting of the top late in the growing season is the most conspicuous symptom. Wilting is then quickly followed by death. Later the tubers show yellow vascular discoloration, followed by breakdown of vascular tissues, the rot spreading to the interior of tubers and to cortex. It is usually followed by discoloration and cracking of the outer surface.

The identity of the causal bacteria has not been definitely established.

The disease is spread principally with the seed, which may or may not show visible infection. It has been demonstrated that it is spread by the cutting knife. It spreads in the field and from diseased plants to healthy ones.

Field inspections for this disease should be made late in the season. It necessitates inspections until the time the vines are dead. Experience in Florida has shown that an average of 10 or 11 per cent affected plants may be expected from stock carrying 1 per cent visibly diseased tubers.

With regard to tolerances, this committee recommends that "the field inspection tolerance be .0 per cent as in the outline." The committee was not in complete agreement regarding bin tolerance. The majority, however, including the representatives from Maine and

Florida, believed that it should remain at .0 per cent at least until more facts have been obtained concerning the seriousness of the disease.

With regard to late blight tolerances, the committee considers both of the tolerances recommended as unpractical. They recommend striking out the mention of the late blight entirely under the heading "field inspection" and substituting 1 per cent for .0 per cent under bin inspection. The U. S. standard apparently permits 6 per cent affected tubers and is considered too liberal.

H. C. Moore presented the following report of the committee on isolation:

In order to reduce increases of diseases, insect damage, and mixtures, potato fields entered for certification should be planted not less than 200 feet from fields not inspected for certification, or from fields showing more than 10 per cent virus diseases.

Certified seed Irish potatoes shall be stored separately from other potatoes, and shall be stored in such a manner and under such conditions that will meet the approval of the certifying official or agency of the state where grown.

The recommendation that fields to be certified should be at least 200 feet from other potato fields caused considerable discussion. It was the general opinion that conditions varied so much in the producing states that it is not wise to select any arbitrary distance. This report was referred to the Correlations Committee but it received no further consideration during the conference.

Mr. J. W. Weston presented the following report of the committee on samples. The number of tubers being used in testing virus and seed transmitted defects follows:

Greenhouse Test:—Nebr., 100; Wis., 200; N. D., 100; Minn., 100.

Confined principally to mosaic.

Field Test:—Nebr., 300 tubers, 2 piece units; N. D., 200 tubers, tuber units.

In greenhouse testing without supplementary field tests, it was recommended that 300 tubers be tested as a minimum.

In the event the greenhouse and field tests are combined, it was recommended that 100 tubers for greenhouse and 200 tubers for field test, making a final number of 300 tubers as a minimum, be used. It was also suggested that testing of greenhouse sample as soon as possible after harvest be practiced.



At the opening of the session on the 7th of April, the presiding officer asked for a report from the committee on hair sprout. E. M. Gillig, Chairman of the committee, responded and stated that the committee had met and discussed the hair sprout trouble for some time but had recessed without coming to any conclusion.

In the discussion that followed, the ideas and points of interest which had been considered by the committee were presented. These included the following:

(1) Nothing definite is known concerning the cause of the hair sprout trouble. Some of the committee, especially members from North Dakota, believed that it was associated with the purple top trouble that was so common in certain sections of the North in the fall of 1937. Others questioned this and thought the trouble was physiological and was brought about by local environmental conditions. There was also the suggestion that the trouble might be caused by a virus.

(2) In the "tentative rules and regulations" which had been presented to the conference on the opening day, there was included a tolerance of 3 per cent on hair sprout. It was suggested that this should be raised to 5 per cent or even higher.

(3) It was brought out that hair sprout could be detected only by germinating the tubers. In order to obtain a germination test, the potatoes would have to be warmed up sufficiently so that they would sprout. A preliminary germination test might not be accurate as it is difficult to force the germination of all the tubers. It was also suggested that sufficient information regarding the percentage of hair sprout might, in many cases, at least, be determined by germinating representative samples.

A motion was made that the committee recommend a tolerance of 5 per cent for the hair sprout. An attempt to amend this motion so that a higher tolerance would be allowed failed.

R. R. Pailthorpe presented the report of the committee on grades, tags, and seals:

In addition to meeting all requirements for U. S. No. 1 grade, the following provisions shall apply to the first grade of certified seed:

1. The size limits shall be  $1\frac{1}{2}$  inches minimum and 12 oz. maximum, unless otherwise specified.
2. Not more than 5 per cent of the tubers can be affected with net necrosis.



3. Not more than 1 per cent shall be allowed for potatoes affected by late blight rot.

4. Not more than 1 per cent of the potatoes shall be affected with spindle tuber.

This committee does not recommend that any state use secondary grades, but where such grades are adopted they shall meet all field, bin, and other disease requirements of the first grade of certified seed stock and at the time of shipment this second grade shall meet the requirement of U. S. Commercial.

It is recommended that, where possible, blue tags be used on first grade seed and red tags on second grade seed, and that samples of tags in use by the certification agency be furnished to the enforcement officers in the consuming states.

It is recommended that an official certified seed tag be attached to each container with a wire and lead or mechanical sealer in such a way as to close the container.

J. G. Leach presented the report of the committee on *Fusarium* wilt and black leg.

**Fusarium wilt:** (1) Inasmuch as stem-end discoloration is not a reliable indication of infection by *Fusarium* wilt, it is recommended that bin inspection for *Fusarium* wilt be discontinued and that stem-end discoloration which cannot be removed without a loss of 5 per cent of the total weight of the potato be considered as a grade defect and subject to grade tolerances only.

(2) Inasmuch as plants affected with *Fusarium* wilt may either fail to produce tubers or produce tubers that will fail to meet the grade requirements, and inasmuch as the available experimental evidence shows that seed piece transmission of *Fusarium* wilt is negligible, it is recommended that the field tolerance for *Fusarium* wilt be omitted from the certification standards.

**BLACK LEG:** Inasmuch as the available evidence shows that seed transmission of black leg is negligible and other sources of infection are so much more important, and inasmuch as appreciable amounts of systematically infected seed will be prohibited by the grade tolerances, it is recommended that the field tolerances for black leg be omitted from the regulations.

J. H. Montgomery presented a joint report of the Regulations and Correlations Committees. This report consisted of a set of uniform rules and regulations which can be adopted by regulatory officials in the various states. It was changed to include the recom-

mendations made by the various committees. The report as adopted is printed below:

WHEREAS, it has been determined that there are various insects and diseases that seriously affect the yield and quality of Irish potatoes when such infested or infected potatoes are used for planting purposes; and,

WHEREAS, it has been demonstrated that the yield and quality of Irish potatoes are improved by planting potatoes that are free or practically free from such insect infestation or disease infection;

THEREFORE, in order to obtain a superior quality of Irish potatoes for planting purposes under the term of "certified seed Irish potatoes," to prevent misrepresentation of seed Irish potatoes as being of superior quality, to prevent the general introduction into and spread within the state of \_\_\_\_\_ of insect pests and plant diseases affecting Irish Potatoes, the (\*certifying agency) under authority of (\*\*state authority) does hereby promulgate the following regulation, declaring the pests; regulated area, restricted material, conditions governing the issuance and use of certificates for the movement of restricted material, inspections and tolerances governing certification, penalties, and effective date.

#### PESTS:

Nematodes	Rhizoctonia	Yellow Dwarf
Late Blight	Leaf Roll	Curly Dwarf
Stem End Discoloration	Giant Hill	Hair Sprout
Mosaic (Rugose)	Spinach Leaf	Bacterial Wilt—Soft Rot
Spindle Tuber	Hay Wire	Rosette
Scab	Net Necrosis	Witches' Broom
	Potato Wart	Mild Mosaic
	Tuber Moth	Sclerotium rolfsii Wilt

#### REGULATED AREAS:

All states of the United States, including (State promulgating regulation).

All territories of the United States.

#### RESTRICTED MATERIAL:

All certified Irish potatoes intended for seed purposes and sold, offered for sale, or distributed as such.

#### CONDITIONS GOVERNING THE ISSUANCE AND USE OF CERTIFICATES FOR THE MOVEMENT OF RESTRICTED MATERIAL:

Restricted material shall not be moved into, within, sold or of-

ferred for sale in the State of \_\_\_\_\_ unless there is firmly affixed to each container an official certified seed Irish potato tag as issued by a properly constituted recognized authority or agency of the State or territory of origin, and unless the containers themselves (if sacks) are closed by the use of a lead seal or mechanical sealer.

Certified seed Irish potato tags will only be recognized when issued by properly constituted and recognized officials or agencies of the states or territories of origin, and upon determination;

(1) That the person, firm or corporation desiring to grow certified seed Irish potatoes had made application to the proper officer or agency in advance of the planting date, giving the source of his or their foundation stock, which must meet with the approval of the certifying officer or agency within the state or territory where grown.

(2) That the material so certified was inspected at least twice while growing and was within the tolerance allowed for various insects and diseases, as hereinafter set forth.

(3) That an inspection of the potatoes at the time of shipment did not disclose diseases or insect pests beyond the tolerances allowed.

(4) That certified seed Irish potatoes shall be stored in such manner as to preserve their identity.

(5) That all certified seed Irish potatoes shall be tagged in such a manner as to set forth that the potatoes in the container to which the tag is attached have met the requirements for certification as herein set forth.

#### INSPECTIONS AND TOLERANCES GOVERNING CERTIFICATIONS:

##### FIELD INSPECTIONS

At least two field inspections shall be made each year at such time as, in the judgment of the certifying agency, is most appropriate. On any one, such inspection pest tolerances shall not exceed the following percentages:

PEST	TOLERANCES PER CENT
Rugose Mosaic .....	2.0
Spindle Tuber .....	2.0
Leaf Roll .....	2.0
Total of above virus diseases not to exceed	3.0
Mild Mosaic .....	5.0
Other diseases known or suspected to be of virus origin, such as yellow dwarf,	

witches' broom, hay wire, giant hill, rosette, spinach leaf, curly dwarf .....	2.0
Sclerotium rolfsii wilt .....	1.0
Tuber Moth .....	0.0
Potato Wart .....	0.0
Bacterial Wilt—Soft Rot .....	0.0

## TUBER INSPECTION—at time of shipment

	<i>Per Cent</i>
Stem End Discoloration .....	4.0
Hair Sprout .....	5.0
Spindle Tuber .....	1.0
Scab and Rhizoctonia .....	6.0 of the tubers, by weight, that have more than 5 per cent of the surface covered by scab or Rhizoctonia.

	<i>Per Cent</i>
Net Necrosis .....	5.0
Tuber Moth .....	0.0
Late Blight .....	1.0
Sclerotium rolfsii wilt .....	1.0
Nematodes .....	0.0
Potato Wart .....	0.0
Bacterial wilt—soft rot .....	0.0

## PENALTIES:

Any person, firm, or corporation found guilty of violating the provisions of this regulation shall be subject to the penalties provided for by

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## EFFECTIVE DATE:

The above Irish potato regulation shall be effective on and after

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The statement was made that the American Potato Growers' Association has a Committee on Certification, and Mr. Koehnke, who is the Chairman, was asked to make a statement in regard to the effect

of this conference on the work of this Committee. In response, Mr. Koehnke stated that the Committee also included Fernow, Darling, Pailthorpe, Eddins, Haskell, Hartman, Martin and Newdick. He said that the discussions at this conference pertained to a great extent to certified seed. As a result of this conference, it was at first thought that recommendations could be made to the Potato Association. The most that can be done is to summarize the various reports as a cross section of the ideas of the people present and use them as a guide for the certification of potatoes in the United States. Mr. Koehnke also stated that a movement was started last year to form an organization of producers and consumers. This conference is, in one sense, a meeting of that group.

A motion was made and carried that the Chairman appoint a committee to report the actions and proceedings of this conference for possible inclusion in the report of the Association of American Potato Growers and for publication in the Potato Journal and that a copy be sent to each person in attendance at the conference.

The chairman appointed the following members on this committee: C. W. Edgerton, E. C. Tims, and L. H. Person.

A motion was made and carried that the Certification Committee of the Potato Association of America be requested to keep in touch with certification problems as they arise throughout the country and suggest meetings similar to this conference when and where they seem necessary.

A motion was made and carried that the Chairman of this Conference with the Secretary, or the Secretary, send to the certification and plant quarantine officials of the United States copies of the uniform Rules and Regulations approved at this conference, for consideration, with the suggestion that they be used as a basis for action regarding conditions under which certified potatoes may be shipped into various states.

## NOTES AND BRIEF ARTICLES

### SEED POTATO CERTIFICATION CONFERENCE

The annual Seed Potato Certification Conference will be held on the 16th and 17th of June at the Spencer Perrine farm near Cranbury, New Jersey. Headquarters will be at the Roger Smith Hotel, New Brunswick. As in previous years, those attending the conference will have an opportunity to examine diseased material sent in by E. S. Schultz, K. H. Fernow, and others. This is one of a long series of conferences of those in charge of certification in the Northeastern States and Canada. A conference of this nature held at this time of year has proved to be a very great value, since it affords an opportunity for the inspectors from the Northern States to study different virus diseases previous to their inspection work. These conferences have unquestionably resulted in more uniform certification rules as well as a more uniform interpretation. All those who are interested in seed potato certification are invited to attend the conference. In order that satisfactory arrangements may be made, please notify W. H. Martin if you are planning to attend.

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### THIRD ANNUAL INTERSTATE SEED POTATO SCHOOL CONFERENCE

C. L. FITCH

*Agricultural Experiment Station, Ames, Iowa*

The third annual Interstate Seed Potato School will be held on the 22d and 23d of June at Ames, Iowa. Everyone interested in certification and good seed, particularly Cobbler seed, is invited

On Wednesday evening the 22d of June at 8 o'clock, there will be a meeting at the village of Crystal Lake (Britt is the railroad station, and cars will be sent there on request for free transportation) for discussion of improved seed Cobblers, and improved onion seed. A talk will be given on the new ideas

concerning viruses. William Chaleen, of Pine City, Minnesota, will show films, part of them colored, illustrating the production of certified seed on his farms. W. F. Haenke, of Gilbert, Minnesota, who has bought a long-time virus-free car of Cobbler seed from Prince Edward Island will be there with some of his neighbors.

On Thursday, the 23d of June at 8 o'clock in the morning and at 1 o'clock in the afternoon, the seed plots near Crystal Lake and Clear Lake will be examined. Mr. Tolaas and I expect to have 520 replicas of 1/200 acre each tagged with virus found in 1937 and in 1938. Dr. Fernow and I are both puzzled as to why yields decreased in 1936 and 1937 roughly parallel to but far more than the virus found. Come and help us guess whether it will work the same way in 1938.

There will be 20 long-time no-virus samples and 80 replicas from Prince Edward Island.

Take the Milwaukee line from Chicago for Britt, to tour with us on the 23d of June. You will be through at Clear Lake before supper time.

Last year we had the certification officials from Minnesota, North Dakota, Wisconsin, and Prince Edward Island with us. Tolaas, of Minnesota, and Isaac, of Montana, will also be there. It is a growers' school, but a good place.

#### FRANK BOGGS

Frank Boggs, formerly of Atlanta, N. Y., died suddenly on the 24th of February, at Hastings, Fla., where he had lived for the past fourteen years. Mr. Boggs made a valuable contribution to the potato industry in the invention of the potato grader which bears his name.

He invented the grader in 1912 and manufactured it at Atlanta, N. Y., until 1916, when he sold his interest to a group of men who organized the Boggs Manufacturing Corporation, of which Daniel Shultz was made president, and H. C. Hatch, vice president. On the death of Mr. Shultz in 1918, Mr. Hatch became president. Mr. Hatch died in 1935 and was succeeded to the presidency by his son, B. W. Hatch. Mr. W. E. Ghent continued as general manager.



## SECTIONAL NOTES

### ALABAMA

Potato shipments in South Alabama are approximately three fourths over. The movement to date from Baldwin County has been 3500 cars. There will be approximately 4700 cars moving from this county. This year the yield will average approximately sixty-five 100-pound bags to the acre. Although the yield has been low, the shipping quality has been good. The potatoes were grown under relatively dry conditions. A rain in late April somewhat upset the market, but continued good weather resulted in potatoes of good carrying quality.

Most of the potatoes in Baldwin County are sold for cash at the grading shed. This system has been quite satisfactory for the majority of the buyers and growers. Cash prices for the season will average approximately 95 cents for U. S. No. 1 size A. The Gulf States marketing agreement went into effect on Thursday, the 12th of May. (May 14).—L. M. WARE.

### CALIFORNIA

There has been a decided improvement in the quality and size of the potatoes which are now being shipped from the Edison District. Even though it was very difficult, earlier in the season, to make a proper US#1 grade—recent shipments are grading US#1, Size A, in a large number of instances.

The yields are also improving and one field last week was reported as yielding 200 sacks to the acre, in contrast to earlier reports indicating an average yield ranging from 50 to 100 sacks.

If favorable weather prevails, the Edison District crop should move from 75-80 per cent by the latter part of this week.

Crop conditions in the Shafter District proper have been improving considerably within the past week. There is no question that there has been more or less damage, first by the early frosts, and, later, by the very heavy rains and even some hail damage. Although there are some fields that look really ragged and will undoubtedly produce a comparatively light yield, still the average fields in the District look so good, we believe Kern County in its entirety will ship at least as many potatoes this season as last. The Santa Fe's estimate regarding the number

of carload shipments from the Shafter District appears to be 12,000 cars. The total shipped from Kern County to date, including the 8th of May, is 679 cars. The demand for these potatoes has been improving and a large percentage of recent shipments has been going to Midwestern and Eastern destinations. (May 10).—WEYL-ZUCKERMAN & Co.

On the 12th of this month, the growers of this county will ballot on the potato referendum pertaining to the Federal Marketing Agreement on early potatoes. It is apparent from conversations among the growers that it will not carry in this area. The growers in this area are inclined to feel that they prefer to work under the California Prorate Act, which permits them to do the same thing but with local control rather than with federal control. As to just how the vote will come out, of course, remains to be seen.

The peak shipments to date in our earliest section, known as the Edison-Weed Patch-Arvin area, has been 81 cars in a single day. The price is now ranging just slightly above \$1.00 for U.S. No. 1's. The yield in this particular section is not heavy. The heaviest yield to date has been approximately 215 one-hundred-pound sacks to the acre. The average probably will not exceed 150 sacks. The cost for each acre on a cash out-of-pocket basis will range approximately from \$55.00 to \$65.00 to the acre. Present prices and present yields are making the growers a little money in this area.

Shipments are expected to begin soon from the Shafter-Wasco area, which is about twenty miles northwest of Bakersfield. A few cars have moved from this area at the present time. Peak shipments in Kern County are expected to be reached probably by the 15th of June. (May 10).—M. A. LINDSAY.

#### COLORADO

Moisture conditions in Colorado have been more favorable this year than any year since 1930. A heavy snowfall in the mountains, beginning early in the fall, generally assures adequate supplies of water for irrigation, and heavy spring rains have assured excellent seed beds for planting. However, the cold, wet weather we are experiencing at the present time is interfering with planting, and the crop will therefore be planted a little later

than usual. Some of the earlier plantings that are above the ground at present have been frosted.

There does not seem to be much of a tendency to reduce potato acreage, although very little profit was realized on the crop just marketed.

Most of the old crop has been disposed of, and no new potatoes from Colorado will appear on the markets until approximately the first of July. (May 9).—C. H. METZGER.

#### GEORGIA

Even though potato plantings were held up a little this year in most sections of the state on account of early heavy rains, the crop at present shows almost a perfect stand and is looking well. With an early spray program in progress, some of the more destructive leaf diseases should be held in check. We anticipate the largest crop in the history of Georgia. (May 13).—H. L. COCHRAN.

#### IDAHO

Potato planting north of Pocatello has just started. Our indicated acreage is about the same as last year. The ground is in ideal condition and the prospects for an abundance of irrigation water are good.

Old potato stocks are about disposed of, with only approximately 1000 cars left in the state. The prices have advanced 25 to 30 cents per hundred during the past week. (May 11).—E. P. WENGERT.

#### INDIANA

Favorable weather permitted our growers of early potatoes to get their crop planted about two weeks ahead of schedule. The potatoes are now showing approximately 100 per cent stand, with very good growth, and are about ready for the first spray. About 85 per cent of the early crop is of the Cobbler variety, the remainder of the crop being of the Early Ohio, Triumph, and a few Warba. There was more demand for certified seed than ever before, since our growers are now beginning to realize the importance of good seed.

Preparations for the late crop are being made with potatoes

being planted from the 15th of May to the 15th of June, although the late Cobbler planting in southern Indiana will not take place much before the latter part of July.

A number of our larger growers are changing from the Rural varieties to the Katahdin and Chippewa since we have found that these varieties yield more marketable tubers to the acre and sell very readily.

The acreage in Indiana will be about the same as last year, approximately 54,000, which will mean that a million to a million and a quarter bushels of seed potatoes will be planted. (May 9).  
—W. B. WARD.

#### KENTUCKY

In the commercial section of Jefferson, Oldham, and Fayette counties, planting was completed by the 25th of April. This date is approximately two weeks later than is normal in this section.

The early-planted potatoes are above ground and the stands are excellent but some uneasiness is felt concerning the stands of the later-planted potatoes on account of the beating rains, and because of rather poor soil preparation. (May 7).—JOHN S. GARDNER.

#### MAINE

Attention in the potato industry here is being focused in the participation and details involved in the Agricultural Conservation Program for 1938. Results to date have been very encouraging indicating that the growers of approximately 95 per cent of the acreage will be co-operating. This should insure an acreage substantially below that forecasted. Most factors in the industry are co-operating wholeheartedly and public sentiment strongly supports stabilization efforts.

The diversion of lower grades into starch is continuing and assurances have been received that operations will be carried on during the remainder of the season. Purchases for relief and the diversion program in starch and by-products have been of great value in stabilizing prices to growers throughout the season. Most competent observers believe that there will be widespread approval of a Marketing Agreement when again submitted.

The planting season is about normal. The ground was ready somewhat earlier than usual but the rainy period during the past few days has delayed operations so that we have lost our original

advantage of a few days. Clover is showing an excellent stand with very little winter killing in evidence, which is a decided contrast to the situation existing a year ago.

It still appears probable that Maine will ship 50,000 cars. The quality of the remaining supplies on hand is excellent and decidedly better than is usually the case at this time of year. Very few sprouts are showing and the tubers continue to remain firm and of the same good cooking quality as we have found all season.

Seed growers are somewhat perplexed this spring in making decisions on plantings. There is a considerable supply of excellent foundation seed available but also many lots were undoubtedly affected by the spread of virus diseases last season. Just what will be the results in terms of acreage approved for certification will remain very much a mystery for some time. The best growers are exercising great care to protect themselves against complications with inferior seed, both for themselves and their neighbors as well. More tuber unit stock is being planted than has ever been true before. The diseased readings of the fields this summer will be awaited with great interest. A determination can be discovered among most growers to produce the kind of seed that merits the buyer's confidence. The success of the seed certification program during the past fifteen years or more must be maintained in the opinion of seed growers who are thoroughly familiar with the industry. (May 14).—FRANK W. HUSSEY.

#### MASSACHUSETTS

Weather conditions have been exceptionally favorable for early planting of the potato crop in Massachusetts. In the earlier sections planting was completed by the end of April but in the later sections some planting of Mountains is still in progress.

Although no estimates of planting are yet available, indications point to a slight increase in acreage compared with last season. Farmers are planting in expectation of possible low prices this fall.

The extremely warm period that occurred the 30th of April occasioned some seed-piece rot from freshly cut seed planted at that time, especially where the seed pieces were planted on dry soils. With this exception, the remaining portion of the crop was planted under ideal weather conditions. (May 9).—RALPH W. DONALDSON.

## NEBRASKA

Applications for certification are being received, and present indications show an increase in the acreage intended for certification during 1938. This increase is being manifested in both dry land and irrigated areas. Because of the Government control program, under the Soil Conservation Service, there seems to be some shift of acreage from commercial to certified, because of the reduced allotments that are being granted to growers.

Because there has been a reduced acreage planted for several seasons, on account of drought conditions, the increase expected will still be below the average planted prior to 1934. A few early commercial plantings are being planted at this time, but the bulk of the crop will not be planted until after the 1st of June. Soil conditions have been ideal, because the rainfall to this time has been more favorable than for several past years. Some growers report that the soil has been soaked four or five feet, as compared with 20 to 25 inches a year ago. Early planted potatoes have been retarded, because of cold weather. The last two weeks have been cooler than March weather, which is a reversal of the ordinary conditions of this territory.

The old crop potatoes, certified seed and table stock, are practically disposed of, and both table stock and seed prices have increased materially. Small quantities of certified seed are selling as high as \$2.50 per cwt. which indicates the shortage existing in the territory.

Indications show a reduction in commercial planting, both dry and irrigated. Part of this is caused by the unsatisfactory sales during the winter, and reduced allotments under AAA. In the irrigated territory the shift seems to be back towards sugar beets, and some other crops which brought in good revenues in 1937. Dry land growers, generally speaking, are feeling very optimistic, primarily because of a more adequate rainfall and the prospects of favorable growing conditions. (May 9)—MARX KOEHNKE.

## NORTH DAKOTA

The potato producing sections of North Dakota have had a great deal of rain this spring, and are in good condition for the production of a normal yield of potatoes. Our planting operations will begin in a few days.



It is expected that the acreage of certified seed potatoes in this state will not be increased above normal, and there is also a possibility of a small decrease. The majority of the growers are making a special effort this year to sort their potatoes very carefully before planting, in order that only the very best and healthiest seed stock will be planted.

Most of the seed growers in North Dakota plant a seed plot in addition to their larger fields, and this year a special effort is being made to plant sizable plots very carefully. (May 12.)—E. M. GILLIG.

### OHIO

There has been a tendency in Ohio to increase the acreage of Cobblers for the past few years. The acreage of Cobblers, Katahdins and Chippewas will be larger this year because of the shortage of Russet Rural seed.

All our Cobblers have been planted. The frost that occurred on the 12th of May has damaged the crop to a slight extent. It is difficult for us to estimate the damage because the plants, in most instances, are not large and should recover easily.

Some counties report a reduction in acreage, whereas others report a slight increase. The total acreage will probably not vary more than three per cent compared with that of last year. (May 13).—EARL B. TUSSING.

### OREGON

Our old potatoes will be nearly disposed of by the 15th of the month. Our estimates indicate that the shipments on hand at that time will not exceed 250 cars. The market is particularly dull and prices are lower than at any other time during the season.

Potato planting started the first of the month and has now reached considerable volume. Planting is usually nearly completed by the 25th of May. The acreage for 1938 will show only a slight reduction from the all-time high of 1937. It is doubtful whether the decrease will exceed 5 per cent.

Our estimated average at present for 1938 will be approximately 18,500, to 19,500 as compared with 20,558 acres in 1937. (May 9).—C. A. HENDERSON.

A low-priced season is coming to an end. The Oregon crop is cleaned up all right, but the bulk of the crop sold for prices around 50 cents, and sacks per hundredweight for U. S. #1's.

There will likely be a slight decrease in acreage, particularly in Western Oregon. As this is written, very few potatoes have been planted. We are getting lots of rain in all sections of the state—the most in twenty or thirty years in Eastern Oregon. This will have little effect on the potato acreage, however, except that a few irrigation projects short of water in past years will have an ample supply this year.

Our big acreage is in Klamath County and they will have about the same acreage as last year.

There is some interest being shown in a marketing agreement. (May 11).—E. R. JACKMAN.

#### SOUTH CAROLINA

The South Carolina potato crop is maturing rapidly and the growers are beginning to dig Irish Cobblers this week. The general crop movement should be under way by the latter part of next week unless unfavorable weather prevents harvesting. It is expected that yields will be rather low as a result of the dry weather which has prevailed during the most of the growing season, but the quality is generally good and the tubers should be clean and bright if dry weather continues.

This year many growers have expressed their intention of shipping the No. 1 potatoes in bags instead of barrels, and a few growers will ship their best grades in bushel tubs. As usual, the bulk of the crop is of the Irish Cobbler variety, but there will be small supplies of Chippewa, Bliss Triumph and Green Mountain.

During this season a number of growers used fertilizers in which all the nitrogen was derived from water-soluble sources such as nitrate of soda, sulphate of ammonia, or urea. This practice has been recommended by the Truck Experiment Station for several years because the fertilizers having all water-soluble nitrogen give just as good, if not better, yields and cost less than the high organic fertilizers. Growers who used the new formula last year were well pleased and are using the same thing again this year. A number of fields was planted this year with the band-placement fertilizer distributor and planter. Growers estimate that the saving in fertilizer and planting operations pays for the

new machine, even if yields are not greatly increased, or not increased at all.

Potato growers in other sections may be interested in knowing that the South Carolina growers are now adding manganese sulphate and magnesium sulphate to their fertilizers as well as dolomitic limestone as a filler and soil corrective. These materials guard against deficiencies and usually result in increased yields. (May 5).—MITCHELL JENKINS.

#### VERMONT

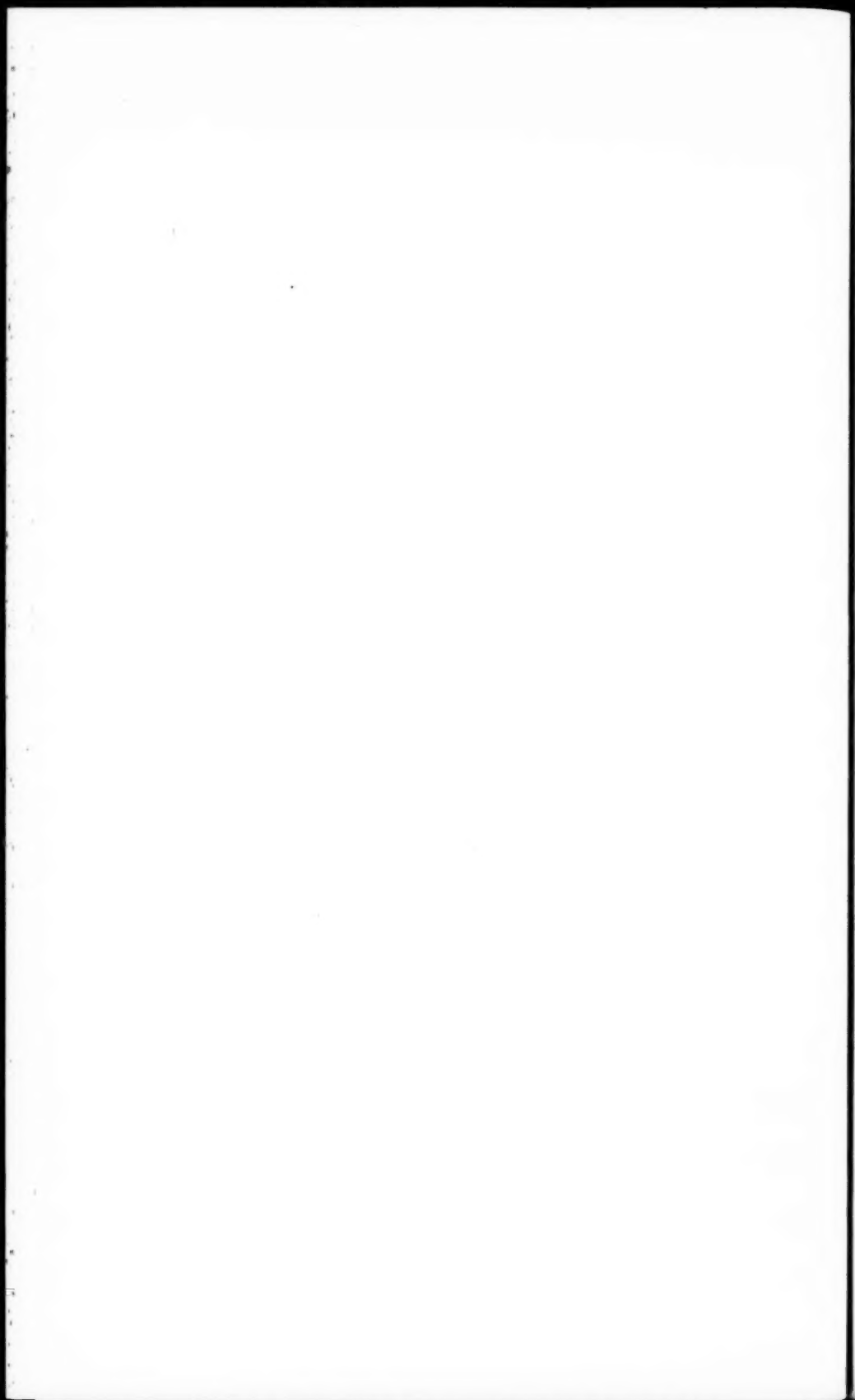
Vermont's certified seed deal was practically closed early in May with only a few small lots left at scattered points. Most of the seed graded well, and only one seed lot had to be disqualified for net necrosis. Percentages made by cutting entire sample lots seldom showed more than one or two tubers in a 25-pound lot.

Indirect reports of a considerable amount of necrosis in certain lots of table stock have been received.

Indications point to a small acreage of fields for certification with entries probably not totalling over 500 acres.

The acreage reduction feature of the soil conservation program will probably have no marked effect on Vermont's total crop, since the great bulk of the crop comes from fields of much less than three acres. Any reduction will be largely in the amount of higher quality seed and table stock in the state, for much of this is grown by producers in the higher acreage brackets.

A small quantity of Earline stock has been provided for trial in Vermont by the Bureau of Plant Industry. It is an early "round white" with apparently good possibilities. (May 12).—H. L. BAILEY.



# Potatoes Like a 1:2:2 Diet

Potato experts in most of the leading potato-growing states are now recommending for average conditions fertilization in an approximate 1:2:2 ratio. Under some conditions even a higher ratio of potash to nitrogen and phosphoric acid is used, especially on sandy soils and mucks or peats. Where growers have been experiencing difficulty in obtaining satisfactory yields of No. 1's, damage from early frosts, or potatoes of poor cooking quality, more potash is used to excellent advantage.

Analyses in the 1:2:2 ratio which are proving popular include: 5-10-10 and 5-10-12 in the Mid-Atlantic states; 4-8-10 and 8-16-20 in New England; and 3-9-18 and 0-8-24 in the Midwest. Rates of application depend upon the plant food available in the soil and the high plant food requirement of the expected yield.

Consult your county agent or experiment station for the best analysis and rate of application for your farm. See your fertilizer dealer or manufacturer. You will be surprised to learn how little extra it costs to apply enough potash to insure profit.

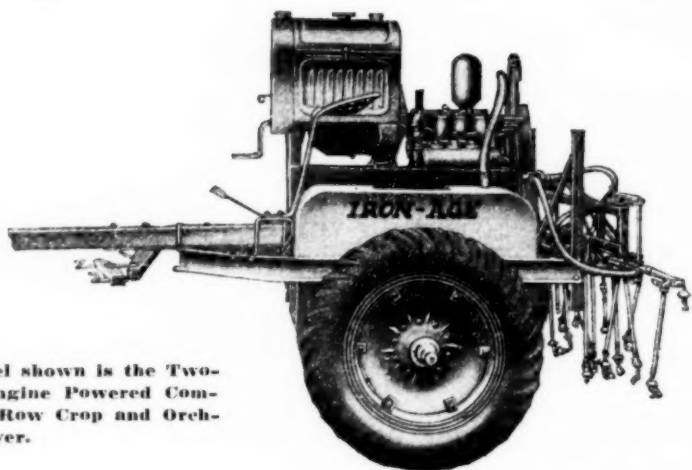
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